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NON-COMMUNICABLE DISEASES AND LIFESTYLE RISK FACTORS: AN EMERGING PUBLIC HEALTH BURDEN IN BANGLADESH

Md. Rifat Hossain[1*], Md. Yousuf[1] and Md. Mortuza Ahmmed[2]

[1]Undergraduate Student, Department of Electrical & Electronic Engineering, American International University-Bangladesh, Dhaka, Bangladesh.

[2]Associate Professor, Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh.

ABSTRACT

In Bangladesh affected patients' non-communicable diseases (NCDs) such as diabetes, hypertension, chronic respiratory illnesses, and cancers are increasing alarmingly. Their prevalence is shaped by lifestyle risk factors, including poor diet, physical inactivity, and tobacco use and social determinants such as health equity, access to services, and variations in nutritional status. A secondary dataset covering the years 1994-2023 was analyzed dividing into three decades to examine disease prevalence in response of health equity, nutritional status, service access, and immunization coverage. Multiple correlation and linear regression were applied to track long-term trend patterns and analyze the relationships among health indicators and key predictors of disease burden. The correlation analysis represents a positive association between the Health Equity Index and disease prevalence (r =0.45) whereas nutrition and immunization coverage showed weaker associations. Similarly, regression analysis identified Health Equity Index as the

strongest predictor for 22% of the variance. The decade-based analysis shows disease prevalence increased 35.8% from (1994 – 2003) to (2004 – 2013) while decreased 17.6% by (2014 – 2023). Despite the many factors Health Equity Index and service access play a vital role for NCDs prevalence. Ensuring the proper mass nutrition, physical activity, health equity and disciplined lifestyle might prevent the rise of non-communicable diseases.

Keywords: *Non-communicable diseases, Lifestyle risk factors, nutritional status, Health Equity Index, immunization coverage.*

Corresponding author: Md. Rifat Hossain can be contacted at 23-55178-3@student.aiub.edu

1. INTRODUCTION

Diseases that are not transmitted from person to person and are of long duration and slow progression, known as Non communicable diseases (NCD) (WHO 2017) have emerged as one of the leading causes of morbidity and mortality worldwide. It accounts for more than two-thirds of global deaths (Biswas et al., 2020; Riaz et al., 2018). Study indicates four major conditions—cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases are responsible for almost 82% of the share of this mortality (Riaz et al., 2018). NCDs appears concentrated in low and middle-income countries and responsible for the largest share of premature NCD deaths (World Health Organization [WHO], 2021).

Bangladesh, like many other LMICs, is undergoing through an epidemiological transition and shows a rising prevalence of NCDs despite of substantial progress in reducing communicable diseases (Kabir et al., 2020). Study represents that, NCDs

account for approximately 67% of total deaths in Bangladesh. (Riaz et al., 2018). Specially, urbanization, demographic shifts and changing lifestyle patterns seems leading causes of the rapid increasing in the NCD prevalence (Biswas et al., 2020) (Directorate General of Health Services [DGHS], 2024).

Several risk factors are responsible for fueling this growing burden exponentially. Tobacco use, physical inactivity, unhealthy dietary practices, obesity, hypertension and diabetes are considered the main reason for increasing the burden of NCD (Riaz et al., 2018). The nationally representative STEPS survey (2018) documented high prevalence of these risks and nearly one in three adults reported insufficient physical activity along with many adults carrying multiple risk factors simultaneously (National Institute of Preventive and Social Medicine [NIPSOM], DGHS, & WHO, 2018; Riaz et al., 2020). These risk factors along with structural challenges such as limited healthcare infrastructure, shortages of trained personnel, and inadequate preventive services often accelerates the risk of long-term disability and premature deaths fuel the crisis by placing excessive pressure on the healthcare system (Kabir et al., 2020).

Despite the evidence of high and rising NCD burden, gaps remain in synthesizing up-to-date prevalence in assessing how population-level health and service indicators influence NCD prevalence over time rather than most studies examine individual risk factors cross-sectionally.

This study addresses the gap by integrating 30 years (1994–2023) of national data and examines the associations between disease prevalence, health equity, nutritional status, service

accessibility and preventive coverage which integrates both socio economic condition and several risk factors together. The purpose of the paper is to examine the association between the risk factors and detect the leading risk factor for NCD prevalence in Bangladesh by first detecting the association of disease prevalence for health equity index, nutritional outcomes, access to services, and preventive coverage and then examining the leading risk factors by the correlation between the factors for NCD prevalence. Thus, the paper will provide an evidence-based understanding of how socioeconomic and health care service contribute to the emerging NCD burden in Bangladesh.

2. REVIEW OF LITERATURE

2.1 Conceptual background and global context

Non-communicable diseases (NCDs) represent chronic, non-infectious conditions of long duration that caused a mix of genetic, metabolic, environmental, and behavioral determinants. The four conditions- cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases are considered as most responsible for global NCD mortality are (Riaz et al., 2020). Globally, NCDs account for the majority of deaths in which a large share of death (almost 80%) is premature mortality (Fottrell et al., 2018). The low- and middle-income countries (LMICs) seems to be affected heavily as these countries progress through demographic and epidemiological transitions (GBD Bangladesh synthesis, 1990–2019). For sustainable public health development, NCDs require sustained, integrated prevention and primary-care management rather than episodic, acute care responses. BMJ Open+1

2.2 Epidemiological trends in Bangladesh

Bangladesh has experienced a significant shift in its disease profile over recent decades. Population-level analyses indicate the rise of NCD-related mortality and disability is exponential while communicable diseases declined (Islam et al., 2023). In the same vein, national estimates indicate that NCDs accounted for a growing proportion of deaths from 2000 through 2019. Moreover, the Global Burden of Disease work documents both absolute and age-standardized increases in NCD burden across major categories in Bangladesh on that period (GBD Bangladesh, 1990–2019). Similarly, regionally representative and facility-based data corroborate these trends, showing increasing prevalence of hypertension, diabetes, and ischemic heart disease and cancer incidence. It appears that population ageing and accelerated urbanization are responsible for amplifying NCD risk which results in increasing health-service demand (Islam et al., 2023). The Lancet+1

2.3 Prevalence of behavioral and metabolic risk factors

Nationally representative surveys and population studies highlight the high prevalence and clustering of NCD risk factors in Bangladesh. According to the STEPS survey (2018) conducted by WHO, majority of adults (approximately 71%) carry at least one modifiable risk factors such as tobacco use, low fruit and vegetable intake, physical inactivity, overweight or obesity, high blood pressure and high blood glucose whereas a substantial proportion presenting multiple coexisting risks (Riaz et al., 2020). Subsequent empirical studies confirm the continued high prevalence of NCD and show variation of NCD depending on sex, age, urban or rural residence and

socioeconomic status. For example, analyses indicate that wealthier and more urban groups have higher obesity and diabetes rates meanwhile tobacco use remains common in lower socioeconomic level (Chowdhury et al., 2023; Riaz et al., 2020). The high degree of risk-factor clustering is particularly important because clustering multiplies individual risk and accelerates progression to multimorbidity. BMJ Open+1

2.4 Social determinants, nutrition, and structural drivers

Beyond individual behaviors, broader social determinants play a significant role in NCD prevalence. Social determinants such as urbanization, dietary transition, shifts in occupational patterns, and inequalities in education and income has shape the NCD risks across the population (Chowdhury et al., 2023). Nutritional change in Bangladesh has been complexing recently. Besides, undernutrition and micronutrient deficiencies seemed permanent in some groups. In the same vein, overweight and diet-related risks (high energy intake, processed foods, excess salt) are rising which causing a double burden that complicates policy responses (Global Nutrition data; Chowdhury et al., 2023). Overall, these transitions interact with weak regulatory environments for unhealthy products consumption such as tobacco and ultra-processed foods that influence diet and activity patterns. PMC+1

2.5 Health-system capacity and policy responses

Although Bangladesh's primary-care and public-health infrastructure has improved general health indicators, yet major gaps remain for NCD prevention, early detection and long-term management. Additionally, insufficient healthcare facilities and

infrastructure as well as the shortage of trained healthcare staff seems exacerbate the burden of NCDs, which results in remarkable pressure on the healthcare system. (The capacity of primary healthcare facilities in Bangladesh to prevent and control non-communicable diseases). Although the primary healthcare system is established at the sub-district level where a range of public and privately-operated health care facilities are functioning, Upazila health complex (UHC), first-level public hospital provides promotive, preventive, curative, and rehabilitative care which located in the headquarter of the sub-district whereas Union-level facilities such as 'Union health and family welfare centers (UHFWC)', 'rural health center (RHD)' and 'Union sub-center' capable of provide outpatient promotive and preventive care. Furthermore, village/wards level healthcare facilities such as Community Clinic (CC) provide outpatients pro motive, preventive care and the private facilities (for-profit) at the Upazila level are mostly focused on curative care while the NGO facilities (not-for-profit) are focused on basic primary healthcare. (Kabir et al., 2023) Consequently, assessments indicate that primary-care facilities are often under resourced for chronic disease management. Moreover, national programs to mainstream NCD services are unevenly implemented which is responsible for the increasing the rate of NCD prevalence (Rawal et al., 2017; DGHS/WHO STEPS documentation). The WHO country profiles and national STEPS documentation point to limited readiness in many settings to handle the rising volume of chronic patients, which threatens to overload tertiary services and generate catastrophic out-of-pocket expenditures for households unless

primary-level detection and prevention are strengthened (WHO country data; STEPS 2018 report).

3. RESEARCH METHODOLOGY

This study employed a quantitative research design to explore the relationships between non-communicable diseases (NCDs) and lifestyle-related determinants in Bangladesh. The approach involved the systematic use of secondary time-series data (1994–2023) and the application of statistical correlation and regression analyses using Microsoft Excel and IBM SPSS Statistics software.

3.1 Data Description

This information was compiled from a number of secondary sources, for instance, World Health Organization (WHO), World Bank Health Indicators, and Bangladesh Bureau of Statistics (BBS). The dataset covers five variables:

- NCD Prevalence (%): Total percentage of reported incidence of non-communicable diseases per year.
- Health Equity Index: Overall indicator of equitability of health care allocation.
- Access to Health Services (%): Proportion of population with frequent access to health centers.
- Immunization Coverage (%): By national population, annually, immunization rate.

- Nutritional Status Index: General indicator of diet and nutrition adequacy.

3.2 Data Analysis

Quantitative analysis was conducted in three stages: descriptive, correlational, and regression analysis.

3.2.1 Descriptive Analysis

Descriptive analysis was used for summarizing general information attributes, such as measures of mean, median, standard deviation, and range. Descriptive statistics give critical information regarding data distribution and variability before inferential testing is performed.

This evaluation revealed early patterns of NCD prevalence and related shifts in public health indicators, including service utilization, equity, and nutrition status.

3.2.2 Correlation Analysis

To identify linear relationships between variables, Pearson's correlation coefficient (r) was computed in SPSS and Excel. The Pearson method measures the strength and direction of associations between continuous variables, defined as:

$$\mathbf{r} = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}}$$

Correlation strength was categorized as weak ($r < 0.3$), moderate ($0.3 \leq r < 0.5$), or strong ($r \geq 0.5$). It assisted in determining which of the socioeconomic factors or lifestyle factors dominated as determinants of NCD prevalence.

3.2.3 Regression Analysis

A multiple linear regression model was applied to examine the combined effect of independent variables (Health Equity, Access to Services, Immunization, and Nutrition) on NCD prevalence. The regression equation used was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where:
Y = NCD prevalence (%),
X_1= Health Equity Index,
X_2= Access to Health Services,
X_3= Immunization Coverage,
X_4= Nutritional Status,
and ε = error term.

The regression coefficients (β) and p-values were interpreted to assess the magnitude and significance of each predictor's influence, with a significance level of $p < 0.05$. The analysis was validated using both SPSS's linear regression module and Excel's Data Analysis, ensuring computational accuracy and reproducibility.

3.2.4 Decade-Wise Comparative Analysis

The risk factors of NCD prevalence during the period 1994-2023 are examined in three decades: (1994 – 2003), (2004 – 2013), and (2014 – 2023). The decade-based analysis shows disease prevalence risk factors in those three decades and aims to identify the leading risk factor in each decade. This analysis also determines the significant shift of risk factors and trends,

as well as the possible factors behind the transition in those three decades.

4. RESULTS

4.1 Trend and Correlation Analysis

Correlation analyses carried out on Microsoft Excel and IBM SPSS Statistics (version 26) revealed that the Health Equity Index is weakly positively correlated with NCD prevalence ($r = 0.45$) before decreasing further for Access to Health Services ($r = 0.23$) and Immunization Coverage ($r = 0.21$). Nutritional Status had a weak association ($r = 0.03$), which suggests that nutritional gains have not had a significant bearing on outcomes of chronic diseases. These results are consistent with Hossain et al. (2024) who found that increased healthcare equity and access have the tendency to bring into the fold previously unaccounted cases, thus increasing the number of recorded cases, as opposed to decreasing incident cases.

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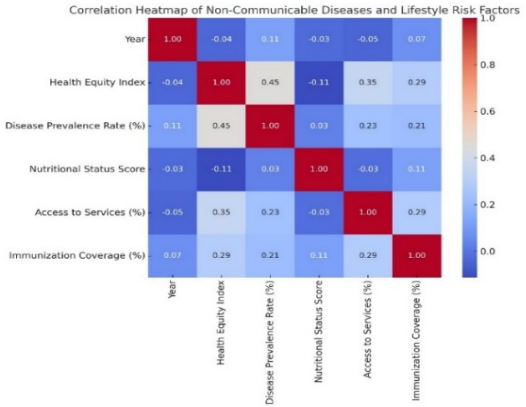

Figure 1. Correlation Heatmap

The time series analysis between 1994 and 2023 shows the trend of disease prevalence rate in Bangladesh along with the risk factors of NCD over the year. From Figure 1 it is notified that, the NCD diseases prevalence rate shows an increasing trajectory before 2004. The disease prevalence rate reached its peak in the period (2004-2008) while nutritional status was lowest at this point. After 2008, the graph of disease prevalence rate shows a downward linear trajectory till 2023.

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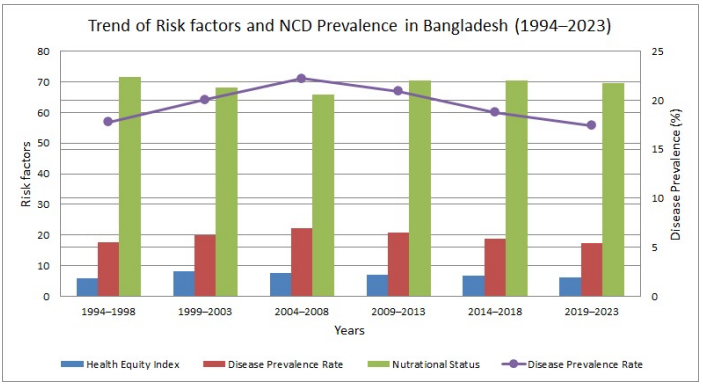

Figure 2. Trend of Risk factors in terms of NCD prevalence in Bangladesh (1994-2023)

4.2 Regression Analysis

The multiple regression model explained 22% of the combined variability in the prevalence of NCD (R^2 = 0.22). Of all the predictor variables, Health Equity Index showed the highest and statistically significant effect (β = +19.3, $p < 0.05$) and, along with Immunization Coverage, was significant, whereas Access to Health Service and Nutritional Status were statistically nonsignificant ($p > 0.05$). Due to these results, again, we assert that the improvement in health equity and accessibility is more impactful on the identification of cases already present, as opposed to the reduction of new cases. Findings are in agreement with Islam et al. (2022) who cited inefficiencies in the response of the Bangladesh Primary Healthcare towards the control of chronic diseases, and with Bhuiyan et al. (2024) who cited that intervention through lifestyle and preventive education is needed as part of systemic reforms towards significant reduction in NCD.

4.3 Decade-Wise Comparative Analysis

To analyze the trend across time in NCD determinants, the study made a comparison of the three consecutive decades' data—Period I (1994–2003), Period II (2004–2013), and Period III (2014–2023)—to determine the trends in population health indicators and their association with the disease prevalence.

4.3.1 Period I (1994–2003)

In the first decade, the average Health Equity Index was 0.661 and the overall disease prevalence rate was 15.59%. This can be considered as the baseline of Bangladesh's epidemiological transition. In this decade, health care coverage was fairly good (72.96%) and vaccination coverage averaged 76.24%. This represents a positive effect of post-primary-health-care programs in the 1990s. However, the nutritional status appears moderate consisting of 68.78, which indicates that diet and micronutrient issues still existed. The highest correlation (r =0.39) was Health Equity Index, which indicates it as leading risk factors while the negative coefficient of immunization coverage represents the reverse association with the NCD prevalence on that period.

This decade overlapped with the era when national health policy was focusing on infectious diseases and maternal–child health without any consideration of chronic diseases. The moderate NCD prevalence thus corresponded with low diagnostic capacity and poor knowledge of lifestyle risk (Rawal et al., 2017).

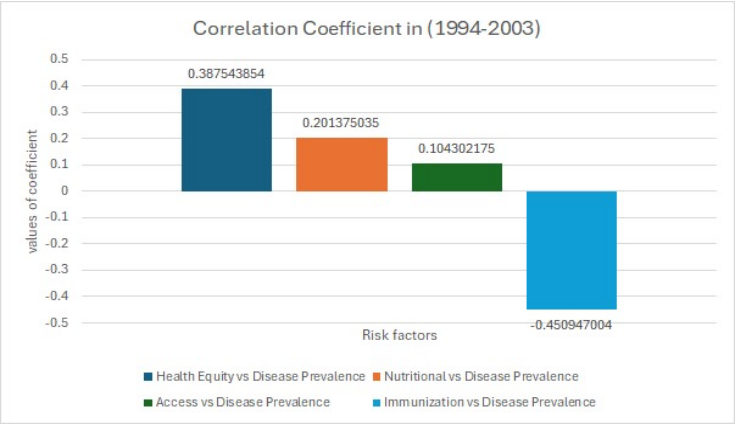

Figure 3. Comparative analysis correlation coefficients in (1994-2003)

4.3.2 Period II (2004–2013)

The second decade featured the highest mean prevalence of the disease (21.17%), as well as the highest Health Equity Index (0.718). Although there was a marginal decline in access to services to 67.54%, improvements in healthcare equity allowed for wider diagnostic coverage and more frequent reporting of cases. Nutritional and immunization indicators also improved to 71.39% and 77.68%, respectively, suggesting general advancement in development. The highest correlation (r =0.52) was Access to Service, which indicates it as the leading risk factor while the negative coefficient of nutritional status represents the reverse association with the NCD prevalence on that period.

This decade overlaps with the country-wide rollout of NCD control programs and improved surveillance systems, which

increased detection of chronic cases more than incidence. The trend is consistent with work by Islam et al. (2022), who noted that expanding diagnostic coverage first raises observed prevalence by picking up existing undiagnosed cases. The decadal peak thus represents Bangladesh's move from underdiagnosis to active detection and responsiveness of the health system.

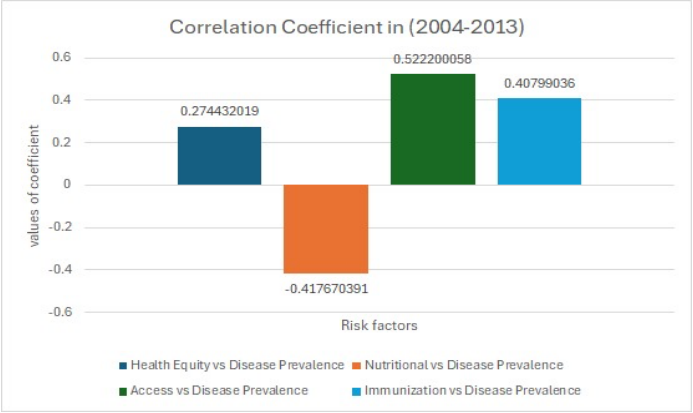

Figure 4. Comparative analysis correlation coefficients in (2004-2013)

4.3.3 Period III (2014–2023): Plateau of Service and Stabilization of Lifestyle

Over this most recent decade, NCD prevalence declined to 17.44% whereas health equity decreased by 0.648. On the other hand, access to services and immunization coverage reached almost saturation with 67.45% and 77.67% respectively. While nutritional status improved slightly to 69.93%. This suggests that Bangladesh's structural health

progress plateaued, yet lifestyle and metabolic risks emerged as the main drivers of disease persistence. The highest correlation (r =0.827) was immunization coverage, which indicates it as the leading risk factor in that period.

The small decline in NCD prevalence reflects greater public awareness and the first impact of preventive interventions. However, continuing dietary evolution and sedentary urban lifestyles, NCD prevalence rate limited further decrease. This interpretation is consistent with Hossain et al. (2024), who described South Asian populations as facing a "double burden" of heightened access but worsening behavioral risks.

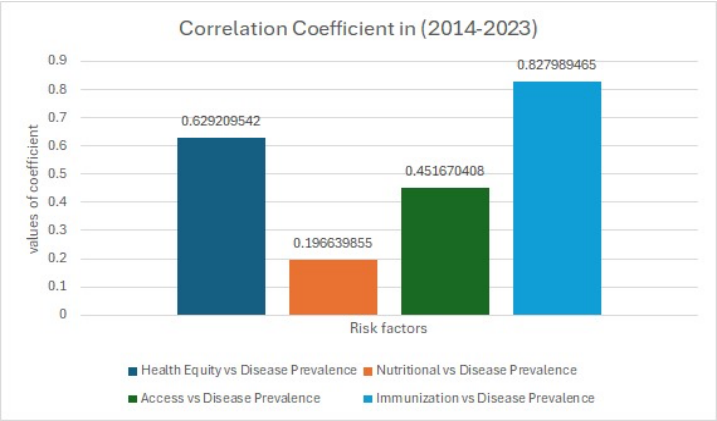

Figure 5. Comparative analysis correlation coefficients in (2014-2023)

4.3.4 Overall Decadal Comparison and Trend Shift

A comparative evaluation of the three decades reveals a progressive transformation of risk profiles and health-system

priorities. It has modified the risk factors an NCD prevalence over the time.

Table 1. Comparative evaluation of Decade-based analysis

Decade	Key Health Characteristic	Main Drivers of NCD Burden	Dominant Risk Factors
1994–2003	Foundation of health equity; low detection	Underdeveloped diagnostic coverage; infectious disease priority	Poor diet quality, low awareness
2004–2013	Rapid diagnostic expansion	Systemic improvements and health surveillance	Urbanization, processed food, inactivity
2014–2023	Lifestyle stabilization, plateau in access	Behavioral and metabolic determinants dominate	Sedentary life, stress, unhealthy diets

Source: The author(s) own work.

The comparative analysis demonstrates a shift in the dominant risk factors from nutritional and structural constraints to behavioral and metabolic factors in recent times. The 2004–2013 decade witnessed the transition of exposing hidden chronic disease burdens through improved equity and reporting systems. By 2014–2023, healthcare access had largely stabilized, but new lifestyle-driven risks began dictating NCD trends.

This confirms the transition of Bangladesh's NCD burden from structural challenge to behavioral. Although the initial interventions were effective in expanding the base of healthcare and improving nutrition, the persisting high prevalence renders prevention-based strategies a compulsion. Future policies need to be directed at health literacy, physical

activity promotion, and diet control, echoing recommendations by Chowdhury et al. (2023) and Bhuiyan et al. (2024).

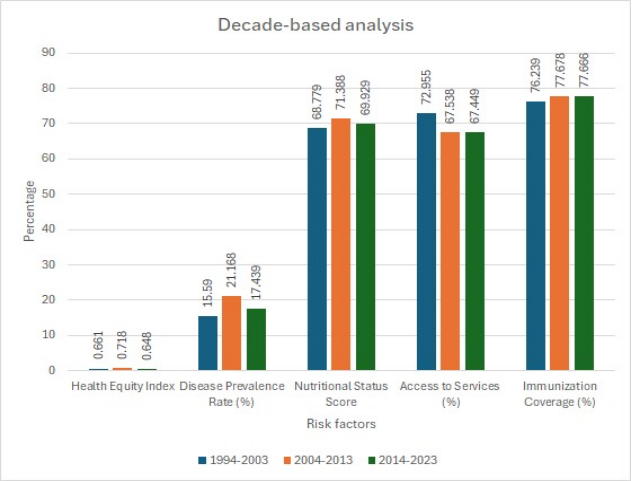

Figure 6. Decade-Wise Risk Factor Analysis

5. DISCUSSION

The findings of this work indicate a persistent and significant growth in the non-communicable disease (NCD) prevalence in Bangladesh from 1994 through 2023. Descriptive data indicate that the average level of NCD prevalence increased from below 10% in the early 1990s to almost 18% in 2023. This increasing trend indicates that despite the enhancement in healthcare access and service provision, non-communicable diseases continue as a persistent and increasing public health dilemma. The risk factors show transitions during the three decades of the period (1994-2023). Improved Health Equity Index and Access to Health Service indicate better healthcare provision,

but these have not efficiently reduced the progress of diseases that are related to lifestyle. This agrees with Riaz et al. (2020) and Chowdhury et al. (2023), who indicated that structural expansion in healthcare cannot suffice as a countermeasure in the behavioral risk exposures that accrue from undesirable diet, physical inactivity, and the consumption of tobacco.

6. CONCLUSION

This 30-year analysis (1994–2023) provides strong evidence of Bangladesh's ongoing epidemiological shift toward chronic, lifestyle-related diseases. The disease prevalence nearly doubled, even as health equity, service accessibility, and immunization coverage improved substantially. Decade-based analysis revealed that while the first decade established healthcare equity, the second decade marked accelerated detection, and the third decade exposed the persistent impact of lifestyle and nutritional transitions.

Regression and correlation findings confirm that health equity contributes mainly to improved diagnosis, while behavioral and dietary risks continue to drive disease incidence. To reverse this trajectory, Bangladesh must integrate NCD prevention into all levels of primary care, prioritize nutrition quality, and promote population-level lifestyle changes. The study underscores that addressing NCDs requires more than healthcare access—it demands a comprehensive transformation in behavior, awareness, and policy orientation for sustainable public health progress.

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